

ORTHOCLASE-BEARING VEINS FROM RAWHIDE, NEVADA AND WEEHAWKEN, NEW JERSEY.

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Lindgren¹ was the first writer to emphasize the occurrence of orthoclase as a vein mineral. He describes the mineral from Silver City, Idaho,² and from Cripple Creek, Colorado.³ Spurr⁴ mentions it from Tonopah, Nevada. Vein orthoclase has also been recorded from several localities in Germany, Austria, Norway, New Zealand and Mexico.

Large orthoclase crystals from veins in the Valenciana silver mine at Guanajuato, Mexico, were described by Breithaupt,⁵ who gave the name valencianite to this variety on account of the abnormal angles.⁶ Lindgren suggests the name valencianite for vein orthoclase. Valencianite has the same habit as adularia, usually pseudorhombic with dominant $m\{110\}$ and $x\{101\}$ and often subordinate $c\{001\}$. Valencianite is a better name to use for vein orthoclase than adularia for the orthoclase of veins is not usually clear and glassy like the typical adularia.

The object of this paper is to describe two occurrences of vein orthoclase, one a quartz-orthoclase replacement vein from Rawhide, Nevada, the other calcite-orthoclase fissure veins from Weehawken, New Jersey.

I. A QUARTZ-ORTHOCLASE VEIN FROM RAWHIDE, NEVADA.

Among a suite of lavas and tuffs collected at Rawhide, Esmeralda County, Nevada, by Mr. H. W. Turner, mining engi-

¹ *Am. Jour. Sci.* (4), Vol. 5, p. 418, 1898.

² 20th An. Report U. S. G. S., part 3, p. 167, 1900.

³ Prof. Paper No. 54, U. S. G. S., p. 187, 1906.

⁴ Prof. Paper No. 42, U. S. G. S., p. 86, 1905.

⁵ *Schweigg. Jour.*, Bd. 60, p. 322, 1830.

⁶ In the University collection there is a specimen of valencianite from Guanajuato. It consists of large (3 cm.) crystals which on account of the curved faces and pearly luster greatly resembles dolomite. The forms are $m\{110\}$ and $x\{101\}$ with very small faces of $c\{001\}$.

neer and geologist, and presented to the geology department of Stanford University, there was found a peculiar quartz-orthoclase rock. This rock was called a dike in the field, but careful examination of a thin section proved it to be a vein. The hand specimen (No. 12) shows white, almost opaque, valencianite crystals (2 mm. in size) in a matrix of quartz. It looks something like an excessively silicified porphyritic rhyolite with the phenocrysts of orthoclase intact.

For notes on the occurrence of this vein and on the geology of the region I am indebted to Mr. E. C. Templeton, who made a study of the rocks and ore-deposits of Rawhide and obtained additional material for the University collections. Rock specimen No. 12 was collected from the surface above the tunnel on the Proske lease by Mr. Turner. Mr. Templeton could not find a rock identical with this but obtained somewhat similar

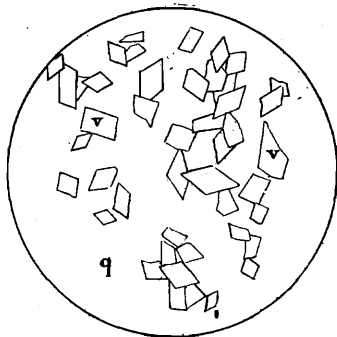


FIG. 427. Valencianite in silicified tuff ($\times 200$). *q* = quartz, *v* = valencianite.

material, evidently from the same vein, at a point fifty feet east of the Proske shaft on the southwest slope of Balloon Hill. Balloon Hill is capped by a rhyolite flow and surrounded on its lower flanks by a silicified rhyolite tuff or dacite tuff. The material described occurs as a single narrow vein up to 17 cm. in width. The vein cuts the silicified tuff, has a vertical attitude, and can be traced for only about fifteen feet. It is evidently a replacement vein rather than a true fissure vein for no comb structure, banding, or brecciation is apparent. It is not very

different from the tuff in appearance and the boundary between the two is not well marked.

The tuff is extensively silicified, consisting principally of secondary quartz and minute valencianite crystals (Fig. 427) with subordinate epidote in fine greenish-yellow aggregates. As the only original minerals are a few remnants of biotite, orthoclase, and plagioclase it is difficult to determine the original character of the tuff. It was probably rhyolitic or dacitic. A low power lens shows white or yellowish angular rock fragments in a rather clear ground-mass and some specimens show fragments of pumice and perlite in the slide. The tuff is usually massive but is sometimes banded white and gray or has a very fine texture.

The rhyolite capping Balloon Hill is a light grayish porphyritic rock showing flow structure. There are phenocrysts of quartz and sanidine but the ferro-magnesium minerals have apparently been replaced by secondary quartz. Secondary quartz is also prominent in the rhyolite and one specimen (No. 21 from Balloon-Mascot lease) contains minute crystals of valencianite which are also secondary.

The vein material consists essentially of quartz and valencianite. Some specimens contain cavities with small valencianite crystals of prismatic habit like Figure 428 (an orthographic pro-

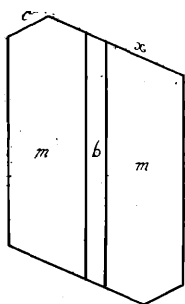


FIG. 428. Valencianite.

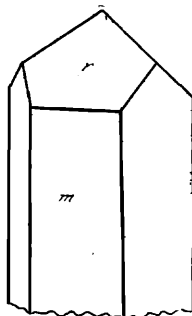


FIG. 429. Quartz.

jection with $m\{110\}$, $b\{010\}$, $x\{\bar{1}01\}$ and $c\{001\}$). A few prismatic quartz crystals terminated with the positive unit rhombohedron $\{1011\}$ alone, were observed (Fig. 429). Thin sec-

tions of the vein material are represented by Figures 430 (No. 12) and 431 (No. 2). The valencianite crystals have a rhombic cross-section with symmetrical extinction. The valencianite is rather

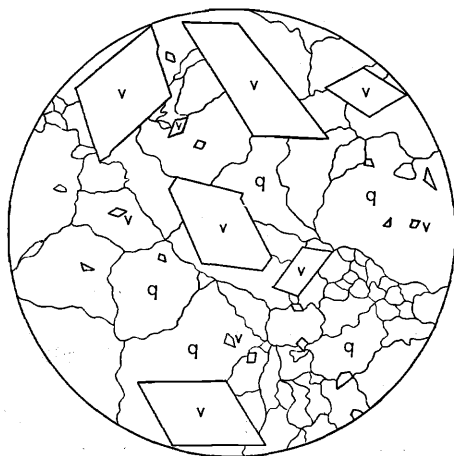


FIG. 430. Quartz-valencianite vein. *q* = quartz, *v* = valencianite. ($\times 40$.)

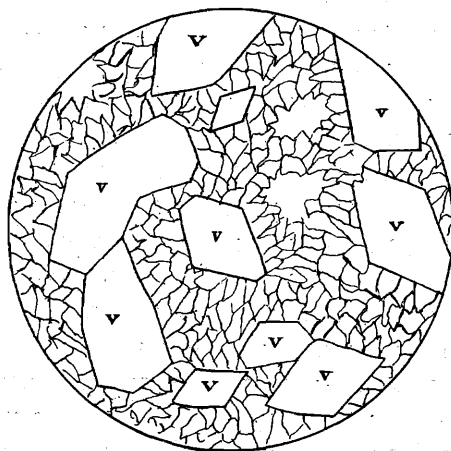


FIG. 431. Quartz-valencianite vein.

cloudy, due to incipient alteration to both sericite and kaolinite. Sericite in minute shreds with high order interference colors occurs in the centers of the crystals while towards the border there is an opaque white mineral which is probably kaolinite.

The valencianite is sometimes optically normal but in some crystals shows interesting optical anomalies. These crystals in polarized light are divided into four sectors which extinguish in diagonally opposite pairs. The extinction angle, measuring from the short diagonal is from 5° to 7° as shown in Fig. 432.

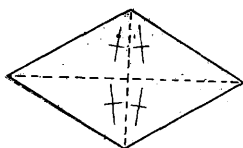


FIG. 432.

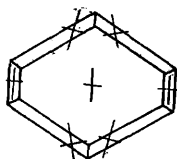


FIG. 433.

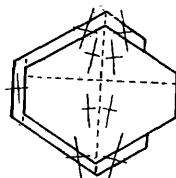


FIG. 434.

FIG. 433. Valencianite bordered by albite.

FIG. 434. Valencianite bordered by albite.

For these observations the large Fuess microscope with rotating nicols (No. VIa.) was used with excellent results. The view that orthoclase is triclinic but submicroscopically twinned receives some support from these observations.

Some of the valencianite crystals have a clear outer zone of albite in parallel position as illustrated by Fig. 433. The extinction angle, measuring from the short diagonal, varies from 8° to 15° , the maximum for albite in the zone $[001:100]$ being 16° . The albite extinguishes in opposite pairs the same as the anomalous orthoclase. In other cases there is clear colorless albite on the exterior in parallel position as shown in Figure 434. At Kirebinsk in the Urals albite¹ is found in parallel position with adularia. Albite has also been found as a vein mineral in California, North Carolina, and Australia.

A partial analysis of the vein material (specimen No. 12, which contained no albite) made by Mr. H. F. Humphrey, assistant in mineralogy at Stanford University, gave the following results: $K_2O=4.10$, $Na_2O=0.28$. As the sericite and kaolinite are very trifling in amount it may be assumed that all of the alkalis are present in the feldspars. The analysis of the rock calculated from the percentages of the alkalis is as follows:

¹ Hintze, "Handbuch der Mineralogie," Bd. II., p. 1466.

SiO ₂	=	90.70	Quartz	=	73.41
Al ₂ O ₃	=	4.92	Valencianite	=	26.59
Na ₂ O	=	0.28			100.00
K ₂ O	=	4.10			
		100.00			

This analysis is abnormally high in silica and low in alumina for an igneous rock. In Washington's Tables of Igneous Rocks¹ the highest silica percentage is 83.59 and only nine are above 80 per cent. The valencianite recalculated gives K₂O=15.48, Na₂O=1.04. A small soda percentage is characteristic of both valencianite and adularia and distinguishes them from other varieties of orthoclase.

The quartz occurs in the interlocking anhedral typical of vein quartz. It also shows optical anomalies. Between crossed nicols the quartz exhibits a radial structure with wavy extinction in sectors. Sections parallel to the *c*-axis, which are rather elongate and give the highest interference color for the

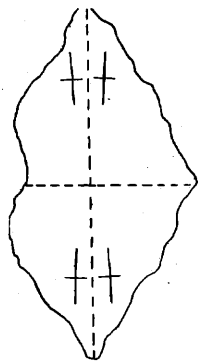


FIG. 435.

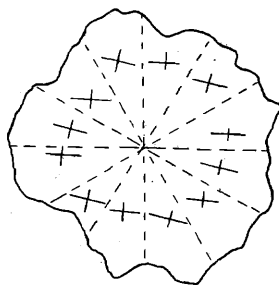


FIG. 436.

slide extinguish in opposite quadrants, the extinction position in the two parts being only about 5° or 6° apart as represented in Fig. 435. Some sections are practically dark between crossed nicols and give a positive interference figure in convergent light. Irregular equidimensional sections, presumably slightly oblique to the *c*-axis, extinguish roughly in alternate sectors 30° apart,

¹ Prof. Paper No. 14, U. S. G. S.

ideally represented by Fig. 436. It is difficult to interpret this optical behavior. Perhaps there are two interpenetrant parts, each occupying half of a dodecant and biaxial, but apparently uniaxial by superposition. Optically anomalous vein quartz from Cripple Creek has been described and figured by Lindgren.¹

The only other minerals occurring in the vein are pyrite, in very small amounts and epidote in greenish-yellow aggregates. Mr. T. N. Turner, assistant in metallurgy at Stanford University, made an assay of the vein material and found 1.4 oz. of silver and 0.5 oz. of gold to the ton.

II. CALCITE-ORTHOCLASE VEINS FROM WEEHAWKEN, NEW JERSEY.

A number of years ago the writer collected specimens from veins in the diabase near Weehawken, New Jersey (on the Hudson River, opposite New York City). These veins are narrow, varying from 2 to 6 cm. in width. They have a vertical attitude and are true fissure veins with banded structure and definite walls. The principal constituents of the veins are valencianite and calcite sometimes with quartz and with subordinate albite, pyrite, chalcopryrite, ilmenite, titanite, and apatite. Some of them contain valencianite with a narrow band of quartz in the

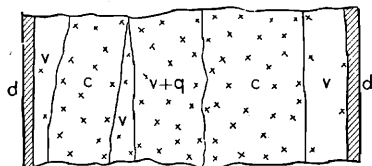


FIG. 437. Vein from Weehawken. *v* = valencianite, *c* = calcite, *q* = quartz, *d* = diabase. The small crosses represent pyrite crystals.

center, while others have calcite in the center of the vein. The widest vein, illustrated by Fig. 437 (natural size), is 6 cm. wide and is more or less symmetrical. There is a narrow zone of valencianite nearest the walls and then a wide zone of cleavable calcite and in the center, valencianite and quartz. Pyrite is scattered all through the vein. Other veins are made up almost

¹ Prof. Paper No. 54, U. S. G. S., p. 179, 1906, Fig. A, plate XVIII., and Fig. C, plate XVII.

entirely of a porous mass of valencianite crystals. Calcite has apparently been dissolved out of these specimens.

The valencianite of these veins is opaque flesh-colored like ordinary orthoclase in appearance but with the habit of adularia. The dominant forms are $m\{110\}$ and $x\{\bar{1}01\}$ with subordinate $c\{001\}$ and sometimes $b\{010\}$. The habit is short prismatic or

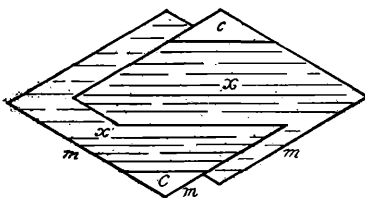


FIG. 438. Carlsbad twin of valencianite. c (001), x ($\bar{1}01$), m (110).

tabular parallel to x . The crystals are about 3 mm. in length. Penetration Carlsbad twins are common. Figure 438 is an orthographic projection of a twin.

In thin sections the valencianite is very cloudy, almost opaque. Albite is often present in spots in the valencianite and around its border. Lindgren noted a similar occurrence at Cripple Creek.¹ In a few cases albite occurred as independent crystals and was identified by the extinction angles of polysynthetic twins. The albite is clear and colorless and perhaps secondary. Several veins of almost pure albite in gray cloudy tabular crystals were observed.

The quartz in thin sections shows optical anomalies something like those described for the quartz from Rawhide, Nevada.

Pyrite occurs in octahedral crystals with subordinate pyritohedron $\{210\}$ and diploid $\{432\}$.

Chalcopyrite was noted in several specimens as small anhedral.

Ilmenite occurs in crystals with elongate cross-sections.

Titanite is prominent in some of the veins as well formed crystals with adamantine luster. It occurs intimately associated with ilmenite and also independently. This is perhaps the first record of titanite as a distinct vein mineral though it is common enough in clefts and seams of schists and gneisses.

¹ Prof. Paper No. 54, U. S. G. S., p. 183, 1906.

Calcite occurs in large cleavable anhedral.

Chlorite is probably represented by a fibrous radiated yellowish green mineral.

A specimen from Bergen Hill, New Jersey, obtained from the Foote Mineral Company, shows the relation of these veins to datolite and the zeolites. A $2\frac{1}{2}$ cm. vein of reddish valencianite (Fig. 439) showing a little of the country-rock on each side had

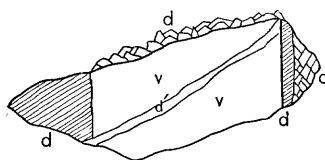


FIG. 439. Section of vein from Weehawken (nat. size). *v* = valencianite, *d* = datolite, *c* = calcite, *d* = diabase.

been fractured (naturally) transversely across and crystallized datolite had been deposited on the fractured surface. A seam of datolite had also penetrated the vein showing clearly that the datolite and zeolites are later and probably independent of the period of vein formation. On another specimen of this kind crystals of apophyllite were found.

The diabase itself is probably the source of the vein materials. The titanium of the titanite and ilmenite is thus easily accounted for. Analyses¹ of the diabase of this region show K_2O percentages varying from 0.39 to 2.10 and thus the valencianite is accounted for.

Lindgren² accounts for the rarity of orthoclase in mineral veins by the abundance of carbon dioxide in thermal waters, saying that "under such conditions the more stable compound—muscovite or sericite—would be formed. . . ." This seems reasonable as a general explanation but it fails in the case of the Weehawken occurrence, for in these veins the calcite must certainly have been deposited from carbonated waters. Moreover, the valencianite and calcite are usually intimately associated.

¹ An. Report of the State Geologist of New Jersey for 1907, p. 121.

² *Am. Jour. Sci.* (4), vol. 5, p. 420, 1898.